USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: 2002WA19G

Title: Using environmental tracers to improve prediction of nonpoint pollutant loadings from fields to streams at multiple watershed scales

Project Type: Research

Focus Categories: Non Point Pollution, Nitrate Contamination, Hydrology

Keywords: catchment hydrology, environmental tracers

Start Date: 07/01/2002

End Date: 06/30/2005

Federal Funds: $157,586

Non-Federal Matching Funds: $212,360

Congressional District: 5

Principal Investigators:
C. Kent Keller
Washington State University

Richelle Allen-King
Washington State University

Shulin Chen
Washington State University

Abstract

The global N cycle has been massively perturbed in the past century by agricultural application of artificially fixed N to the terrestrial environment. In the US, tens of thousands of river and shore reaches are considered impaired by the EPA, and many of these impairments are believed to be attributable to agricultural non-point sources. In this context a key policy goal must be to develop understanding of how agricultural streamwater N loading is affected by field-scale hydrologic processes in various climate / cropping associations.

The watershed-environmental-tracer approach has strong potential as a practicable way to address the problem of understanding sources and pathways of N loading to streams in agricultural basins. This approach uses geochemical tracers as signatures of flow pathways in combination with conservative isotopic tracers (e.g. oxygen-18) which contain transport-time information. We propose to apply this approach in the Palouse River Basin which features semiarid climate, strongly seasonal rainfall-runoff patterns, dryland chemical-fertilizer-intensive cultivation of dominantly silt-loam soils, and a combination of tile-drained and undrained fields. Existing data indicate that streamwater nitrate concentration varies positively with stream discharge, both of which are greatest during the winter.

We hypothesize that stream nitrate discharge, from field and small catchment to basin scales, is principally controlled by the response of field-scale flow and transport processes to drainage regime and seasonal hydrology. The roles of biologic processes are rapid nitrification of fertilizer ammonia beneath bare fields

in the fall, generating the nitrate reservoir for cold-season transport, and uptake of water and nitrate by plants as the runoff season yields to the growing season. We propose to test this hypothesis by utilizing existing infrastructure and experience to (a) expand our study of field-scale processes to include undrained settings, and (b) develop a spatially- and temporally-detailed O-18 data set which can be used, in parallel with geochemical data sets, for simultaneous isotope and geochemical hydrograph separations at multiple watershed scales.

Our proposed work will yield multiple practical benefits. Working with regional USGS collaborators and with other USGS colleagues around the country, we plan to show that existing high-quality stream-gauging databases may be modestly augmented to yield useful insights into up-basin N-loading processes. A minimum of 4 graduate and undergraduate students will be supported and trained. We will help USGS WRD to maintain and enlarge the data base for their Hooper NAWQA stream gauging site. We will work with USDA/ARS colleagues on interpreting our data from the agroecosystems perspective and disseminating the practical implications of our findings to growers. Data sharing with the Palouse Basin Aquifer Committee will help delineate the water resources future of the Moscow-Pullman area and maintain lines of technical communication between NAWQA and local agencies.